

NATIONAL ORGANIC STANDARDS BOARD
COMMENT ON HANDLING COMMITTEE RECOMMENDATIONS
RELATIVE TO “AGRICULTURAL” AND “NONAGRICULTURAL” SUBSTANCES

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August 2, 2005

Can we consider that *Saccharomyces cerevisiae* (yeast) is an agricultural product and can we consider if it is the case that *S. cerevisiae* organically produced must be considered as organic?

The proposition enacted by the Handling Committee which proposes that yeast will be classified as non-agricultural substance and not as an agricultural product was based on a scientific incorrectness. It distinguishes the fungi, making a difference between the higher fungi (mushrooms) and the simple fungi as the yeasts on the basis of the presence or not of mycelium OR fruiting bodies. The Handling Committee affirms that yeast has no fruiting bodies. What is a fruiting body? *Sensu stricto* it is a differentiated organ coming from a sexual mating and containing cells which leads to a novel organism: We affirm that is also the case with *Saccharomyces cerevisiae*.

***Saccharomyces cerevisiae* is a single-celled organism, part of the kingdom Fungi.**

Saccharomyces cerevisiae is the botanical name of the strain of yeast also named baker's or brewer's yeast, most often used for wine, beer or bread making. *S. cerevisiae* is commonly isolated from fruits, grapes, trees, plants, olives. It is a species of budding yeast and it was the first eukaryote to have its entire genome sequenced (1996, 16 chromosomes for the haploid form, 6000 genes, 13.10**6 bp). It is the model organism in molecular and cell biology and a genetic tool. *S. cerevisiae* cells are used frequently as simple eukaryotic host organisms for the expression of heterologous eukaryotic genes even if they contain introns and most proteins are processed and modified correctly. *S. cerevisiae* cells have the advantage of being an eukaryotic organism and resemble plant and animal cells with respect to complexity in spite of their small size. The structure of the cell wall is near the cellulosic structure of a plant cell.

The life cycle of *Saccharomyces cerevisiae*, morphological change and sexuality

Fungi (including mushrooms) are homothallic (self fertile) or heterothallic (out-crossing). *S. cerevisiae* is heterothallic;

Simply, *S. cerevisiae* can exist and live both as a haploid (one copy of the 16 chromosomes per cell) or as a diploid (two copies of each chromosome per cell) organism. Haploids which reproduce asexually exist as one of two mating types named α and a .

The proposed Guidance Document presented by the Handling Committee states that yeasts are distinguishable from fungi that form mycelium because yeasts, in addition to being unicellular, “reproduce asexually.” This is only partly correct. *S. cerevisiae* can reproduce also sexually as other fungi. They are heterothallic organisms as other mushrooms. When two haploids of opposite mating types are closed together, they cause in each other the arrest of the G1 growing phase of the cell cycle. Each subsequently under hormone control grows a

special protuberance towards the mating partner producing a characteristic “schmoo”. As in the plant or in the animal kingdoms, a haploid strain can only mate with another haploid of the opposite mating type. The result of the mating (karyogamy) is a diploid cell. Haploids or diploids are stable and can grow. In the presence of appropriate nutrients both type of cells are capable of repeated cycles of vegetative growth (mitosis).

It is also not accurate to state that yeasts cannot produce fruiting bodies. In the presence of a poorly utilised carbon source (acetate for example) and in absence of a nitrogen source, the diploid strain switches to sporulation, the second mode of development pathway by meiosis, and spores formation. The sporulation gives rise to a structure termed ascus which must be considered as a fruiting body which contains four ascospores (two α and two a). (*S. cerevisiae* belongs to ascomycetes). These ascospores (haploids) will germinate in good nutrient conditions to lead to a haploid cell.

Conclusion

Considering the life cycle of *Saccharomyces cerevisiae* with the sexual mating and the spores formation into the Ascus which is a fruiting body, yeast must be considered as an agricultural substance.

Considering that it is possible to produce yeast following the organic guidelines, it must be considered as organic.

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